Correlates of Repeat Lipid Testing in Patients With Coronary Heart Disease

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IMPORTANCE Understanding the frequency and correlates of redundant lipid testing could identify areas for quality improvement initiatives aimed at improving the efficiency of cholesterol care in patients with coronary heart disease (CHD).

OBJECTIVE To determine the frequency and correlates of repeat lipid testing in patients with CHD who attained low-density lipoprotein cholesterol (LDL-C) goals and received no treatment intensification.

DESIGN, SETTING, AND PARTICIPANTS We assessed the proportion of patients with LDL-C levels of less than 100 mg/dL and no intensification of lipid-lowering therapy who underwent repeat lipid testing during an 11-month follow-up period. We performed logistic regression analyses to evaluate facility, provider, and patient characteristics associated with repeat testing. In total, we analyzed 35,191 patients with CHD in a Veterans Affairs network of 7 medical centers with associated community-based outpatient clinics.

MAIN OUTCOMES AND MEASURES Frequency and correlates of repeat lipid testing in patients having CHD with LDL-C levels of less than 100 mg/dL and no further treatment intensification with lipid-lowering therapies.

RESULTS Of 27,947 patients with LDL-C levels of less than 100 mg/dL, 9,200 (32.9%) had additional lipid assessments without treatment intensification during the following 11 months (12,686 total additional panels; mean, 1.38 additional panel per patient). Adjusting for facility-level clustering, patients with a history of diabetes mellitus (odds ratio [OR], 1.16; 95% CI, 1.10-1.22), a history of hypertension (OR, 1.21; 95% CI, 1.13-1.30), higher illness burden (OR, 1.39; 95% CI, 1.23-1.57), and more frequent primary care visits (OR, 1.32; 95% CI, 1.25-1.39) were more likely to undergo repeat testing, whereas patients receiving care at a teaching facility (OR, 0.74; 95% CI, 0.69-0.80) or from a physician provider (OR, 0.93; 95% CI, 0.88-0.98) and those with a medication possession ratio of 0.8 or higher (OR, 0.75; 95% CI, 0.71-0.80) were less likely to undergo repeat testing. Among 13,114 patients who met the optional LDL-C target level of less than 70 mg/dL, repeat lipid testing was performed in 8,177 (62.4% of those with LDL-C levels of <70 mg/dL) during 11 follow-up months.

CONCLUSIONS AND RELEVANCE One-third of patients having CHD with LDL-C levels at goal underwent repeat lipid panels. Our results highlight areas for quality improvement initiatives to reduce redundant lipid testing. These efforts would be more important if the forthcoming cholesterol guidelines adopt a medication dose-based approach in place of the current treat-to-target approach.

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The Institute of Medicine’s report, *Crossing the Quality Chasm: A New Health System for the 21st Century*, defines good-quality care as care that is safe, effective, patient centered, timely, efficient, and equitable. Efficient care is defined as care that avoids waste of health care resources. A more recent report from the Institute of Medicine concluded that 30 cents of every health care dollar spent in the United States is wasted. This report and recent efforts to reduce overuse (eg, the Choosing Wisely campaign) have called for efforts to improve health care operations to reduce waste and focus on activities that improve patient health.

Current performance measures in patients with coronary heart disease (CHD) that are based on the Adult Treatment Panel III guidelines suggest annual lipid testing in patients with CHD, followed by treatment intensification in those with abnormal lipid levels. Although the frequency and correlates of treatment intensification for elevated low-density lipoprotein cholesterol (LDL-C) levels in patients with CHD have been studied, the frequency and correlates of repeat lipid testing in patients with CHD who have already attained Adult Treatment Panel III guideline-recommended LDL-C treatment targets and received no treatment intensification (to further lower LDL-C levels or to treat other lipid abnormalities) are unknown. In these patients, repeat lipid testing may represent health resource overuse and possibly waste of health care resources. The aim of our analysis was to determine the frequency and correlates of repeat lipid testing in patients with CHD who have already attained the guideline-recommended LDL-C target of less than 100 mg/dL and received no further treatment intensification (to convert cholesterol levels to millimoles per liter, multiply by 0.0259).

**Methods**

**Study Population**

The protocol was approved by the institutional review boards at Baylor College of Medicine and the Michael E. DeBakey Veterans Affairs Medical Center. We identified patients having CHD with a primary care visit in a Veterans Affairs (VA) network of 7 medical centers with associated community-based outpatient clinics between October 1, 2008, and September 31, 2009. We identified patients as having CHD using *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnoses and procedure codes for percutaneous coronary intervention or coronary artery bypass grafting (eTables in the Supplement) for up to 2 years preceding the study interval. We included patients with at least 2 outpatient diagnosis codes or 1 inpatient diagnosis code for unstable angina or with 1 code for myocardial infarction, percutaneous coronary intervention, or coronary artery bypass grafting.

Using VA administrative and clinical data sources (including clinic stop codes), we identified patients having CHD with a primary care visit between October 1, 2008, and September 31, 2009. We then identified the most recent lipid panel performed within 12 months before the patient’s most recent primary care visit during the study interval (the index lipid panel). We ascertained patient characteristics, including age, sex, race/ethnicity, and the number of primary care visits in the 11 months following the index lipid panel, as well as any history of diabetes mellitus (DM) or hypertension (eTables in the Supplement). Using the prescription fill date and the medication supply days, we estimated each patient’s adherence to lipid-lowering medications by calculating the medication possession ratio as the number of days the patient had lipid-lowering medication in the 180 days before the patient’s visit per 180 days. A medication possession ratio of 0.8 or higher is a well-described measure of patients’ medication adherence.

We studied facility and provider characteristics, including whether the facility was a teaching facility, whether the primary care provider was a physician or nonphysician such as a nurse practitioner or physician assistant, and whether the provider was a specialist performing primary care or a non specialist performing primary care, as well as the number of patients in a provider’s panel. To assess the influence of patients’ illness burden in a provider’s panel on repeat lipid testing, we calculated the mean Diagnostic Cost Group Relative Risk Score for all patients with CHD in a provider’s panel. This score is a ratio of predicted to actual mean cost of the VA population and has been used as a measure of a patient’s overall illness burden. For example, a patient with a score of 2 is expected to be twice as costly, with a mean illness burden twice as high as that of an average patient.

**Outcomes and Analyses**

We identified patients having CHD with LDL-C levels of less than 100 mg/dL who had repeat lipid testing performed in the 11 months following the index lipid panel (Figure). Although current performance measures recommend lipid testing on a yearly basis in patients with CHD, we used a follow-up window of 11 months (rather than 12 months) to account for the fact that some patients could undergo repeat lipid testing in the month before their annual follow-up visit. Because Adult Treatment Panel III treatment guidelines allow further lipid-lowering treatment intensification in patients with CHD to an optional LDL-C target of less than 70 mg/dL, we identified the proportion of patients having CHD with LDL-C levels of 100 mg/dL who underwent repeat lipid testing without intensification of their lipid-lowering medication regimen. In these patients, it is likely that repeat lipid testing was performed without any clinical action (ie, could be redundant). We defined treatment intensification as the initiation or addition of a lipid-lowering medication or an existing lipid-lowering medication dosage increase in the 45 days following the index lipid panel. We included statins, niacin, fish oil, fibrates, ezetimibe, and bile acid–binding resins in our definition of treatment intensification because treatment intensification in a patient having CHD with an LDL-C level of less than 100 mg/dL could indicate treatment to lower the LDL-C level to less than 70 mg/dL or to lower the triglycerides level or raise the high-density lipoprotein cholesterol (HDL-C) level.

We performed logistic regression analyses to identify facility, provider, and patient characteristics independently associated with repeat lipid testing in patients having CHD with...
LDL-C levels of less than 100 mg/dL without treatment intensification. All facility, provider, and patient variables were entered in a model to ascertain which characteristics were independently associated with repeat lipid testing. Because the random variance in care could differ significantly secondary to clustering of patients between facilities, we also adjusted for clustering of patients at the facility level in our regression models using generalized linear latent and mixed models in a statistical software program (STATA, version 11; StataCorp LP). In sensitivity analyses, we also adjusted for random variance secondary to clustering at both facility and provider levels using generalized linear latent and mixed models. We conducted the analyses using software programs (STATA, version 11 and SAS, version 9.1.3; SAS Institute, Inc).

**Results**

Of 36,643 patients with CHD identified, 1452 were excluded because of missing data on lipid panels or treatment intensification. Therefore, our final cohort included 35,191 patients with CHD (Figure). The LDL-C levels were less than 100 mg/dL in 27,947 (79.3%). Among these patients with a LDL-C level of less than 100 mg/dL, 9200 (32.3%) had at least 1 lipid panel performed in the 11 months following the index lipid panel without treatment intensification. The total number of additional lipid panels in these 9200 patients with CHD was 12,686 (mean, 1.38 additional lipid panel per patient). In sensitivity analyses that extended the treatment intensification window from 45 to 60 or 90 days from the index lipid panel, 9046 and 8826 patients underwent repeat lipid testing without treatment intensification at 60 and 90 days, respectively.

Table 1 gives the baseline characteristics of 9200 patients with CHD who underwent repeat lipid testing without treatment intensification (study patients). Their mean age was 72.8 years, with predominantly male patients of white race/ethnicity. There were high prevalences of hypertension (86.2%) and DM (43.9%). Almost 72% of the study patients were taking statins, although only 24.4% were adherent to their lipid-lowering medication regimen (medication possession ratio, ≥0.8). The study patients had well-controlled lipid levels, as evidenced by mean baseline LDL-C, non-HDL-C, triglycerides, and HDL-C levels of 70, 94, 123, and 43 mg/dL, respectively (to convert triglycerides level to millimoles per liter, multiply by 0.0113).

Table 2 summarizes the association between facility and provider characteristics and repeat lipid testing. Adjusting for clustering of patients at the facility level, receipt of care at a teaching facility (odds ratio [OR], 0.74), from a physician provider (OR, 0.93), or from a provider with a large panel size (OR, 0.98 per 100 patient increase in panel size) was associated with a lower likelihood of repeat lipid testing. Conversely, an increase in the illness burden of patients in a provider’s panel (a higher Diagnostic Cost Group Relative Risk Score) was associated with a higher likelihood of repeat lipid testing.

Table 3 gives patient characteristics associated with repeat lipid testing. Patients with CHD older than 65 years, those with a history of DM (OR, 1.16) or hypertension (OR, 1.21), and those with more primary care visits (OR, 1.32) were more likely to receive repeat lipid testing. Conversely, patients having CHD with a medication possession ratio of 0.8 or higher (OR, 0.75) were less likely to receive repeat lipid testing.

We also evaluated the frequency of treatment intensification following the repeat lipid panel in the 9200 study patients. Our analyses showed that treatment intensification was performed in only 6.5% (595 patients) at 45 days following the repeat lipid panel. Next, we analyzed the timing of repeat lipid panels in study patients (eTables in the Supplement) and found that 34.2% of the repeat lipid panels were performed by 6 months and 79.9% by 9 months from the index lipid panel. An analysis of clinic visits in these patients showed that 79.9% of repeat lipid panels were performed within 1 month of a primary care visit. Last, we evaluated the association of LDL-C, non-HDL-C, triglycerides, and HDL-C levels on repeat lipid panels in study patients. These lipid panel results were strikingly similar to the index lipid panel results (the mean LDL-C, non-HDL-C, triglycerides, and HDL-C levels on repeat lipid panels were 71, 96, 133, and 43 mg/dL, respectively) and argue against major medication or therapeutic lifestyle changes as the drivers of repeat lipid testing.

We also evaluated the frequency of repeat lipid testing in 13,114 patients having CHD with LDL-C levels less than 70 mg/dL. Among these patients who also met the optional LDL-C

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repeat lipid testing represents aggressive LDL-C treatment to the optional target of less than 70 mg/dL² or treatment of other lipid variables, it is important to note that we excluded patients having CHD with LDL-C levels of less than 100 mg/dL who had further treatment intensification with lipid-lowering medications (Figure). In addition, our study patients already had well-controlled lipid levels (Table 1). Collectively, these 9200 patients with CHD had a total of 12 686 additional lipid panels performed. With a mean lipid panel cost of $16.08 based on Veterans Health Administration laboratory cost data,¹⁵ this is equivalent to $203 990 in annual costs for one VA network and does not take into account the cost of the patient’s time to undergo lipid testing and the cost of the provider’s time to manage these results and notify the patient. As per the current debate in the literature,¹⁶,¹⁷ if the forthcoming Adult Treatment Panel IV cholesterol management guidelines adopt a statin dose–based approach as opposed to the current treat-to-target approach, then the need for frequent cholesterol testing in patients with CHD would be reduced even further.

Our results show that an increase in the illness burden of patients in a provider’s panel was associated with more frequent lipid testing. Combined with a greater likelihood of repeat lipid testing in patients having CHD with concomitant DM or hypertension, this points toward a tendency of health care providers to order frequent laboratory testing in complex patients. Frequent lipid testing in these patients likely represents providers’ practice to order comprehensive laboratory tests (including lipid levels) rather than focusing on one clinical issue (eg, ordering glycated hemoglobin measurement to assess diabetes control). Our results also show that patients receiving more frequent primary care visits were more likely to undergo repeat lipid testing. More frequent primary care visits in a patient having CHD with well-controlled lipid levels could represent other illnesses (eg, uncontrolled DM) that sometimes require frequent monitoring of laboratory values, such as glycated hemoglobin level. Even when these illnesses are well controlled, repeat lipid testing likely provides...
Repeat Lipid Testing in Patients With CHD

Table 3. Patient Characteristics Associated With Repeat Lipid Testing After Multivariate Regression Analyses Adjusting for Clustering at the Facility Level

<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.28 (1.00-1.65)</td>
<td>.05</td>
</tr>
<tr>
<td>Male</td>
<td>1 [Reference]</td>
<td>NA</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;65</td>
<td>1 [Reference]</td>
<td>NA</td>
</tr>
<tr>
<td>≥65 to &lt;75</td>
<td>1.14 (1.06-1.22)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥75</td>
<td>1.32 (1.24-1.40)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>1.09 (0.98-1.20)</td>
<td>.10</td>
</tr>
<tr>
<td>White</td>
<td>1 [Reference]</td>
<td>NA</td>
</tr>
<tr>
<td>History of diabetes mellitus</td>
<td>1.16 (1.10-1.22)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>History of hypertension</td>
<td>1.21 (1.13-1.30)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Medication possession ratio</td>
<td>0.75 (0.71-0.80)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of primary care visits</td>
<td>1.32 (1.25-1.39)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviation: NA, not applicable.

ARTICLE INFORMATION

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Author Contributions: Dr Virani had full access to all the data in the study and takes responsibility for the integrity of the data and for the accuracy of the data analysis. Study concept and design: Virani, Landrum, Chen, Hertz, Petersen. Acquisition of data: Woodyard, Wang, Chitwood, Petersen. Analysis and interpretation of data: Virani, Woodyard, Wang, Landrum, Urech, Pietz, Chen, Murawsky, Ballantyne, Petersen. Drafting of the manuscript: Virani, Chen, Hertz. Critical revision of the manuscript for important intellectual content: Virani, Woodyard, Wang, Chitwood, Landrum, Urech, Pietz, Chen, Murawsky, Ballantyne, Petersen.

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REFERENCES


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Physician Performance Measurement

The Importance of Understanding Physician Behavior

Joseph P. Drozda Jr, MD

When national professional organizations, such as the American Medical Association convened Physician Consortium for Performance Improvement and the American College of Cardiology and American Heart Association Task Force on Performance Measurement, first began developing nationally standardized physician performance measures more than 10 years ago, the objective was fairly simple: provide physicians with tools to assist them in improving the quality of care. The direction of measures development quickly changed to support the exponential growth in both the number and complexity of physician incentive and public reporting programs that has occurred in the last decade. Until recently, these programs and their concomitant measures were focused on reports that American patients were not receiving required services as exemplified by the oft-quoted study by McGlynn et al, which concluded that 54.9% of patients were not receiving “recommended care.” Messengers addressing guideline-recommended care (eg, lipid and hypertension management) were created to help improve this performance.

For measures developers, the challenges of creating measures for use in physician accountability programs (rather than solely for internal quality improvement) have been many, including assessing measures feasibility and reliability, attention to risk adjustment where appropriate, and the development of appropriate methods for determining measures exceptions. Although designers of physician-level “accountability programs” have given considerable thought to these issues, as well as to concerns regarding statistical significance and unintended consequences, the implementation science supporting such programs (especially in the area of chronic care) is still in its infancy with many unknowns, including their effect on physician behavior.

As public and private physician incentive programs become more pervasive and have a greater effect on physician compensation and professional standing, we can expect physician behavior to change. The exact form and extent of that change remain largely unknown, although we are getting some early hints of what we might expect through a series of studies from the Department of Veterans Affairs (VA).

A review of patient records at the San Francisco (California) VA Hospital by Walter et al, which was precipitated by the threat of financial penalties to the hospital if colorectal cancer screening rates were not increased, revealed among other findings that this incentive could lead to overuse of screening...